


FAA National Software Conference

Field-Loadable and User-Modifiable Software

Field-Loadable Software
N8110.77 and N8110.79



Will Struck
FAA TAD ANM-111
will.struck@faa.gov

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Two Field-Loadable Notices

- N8110.77 - "Guidelines for the Approval of Field-Loadable Software"
- N8110.79 - "Guidelines for Approval of Field Loadable Software by Finding Identity through the Parts Manufacturer Approval Process"

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Purpose of Notice

- Purpose:
 - To Provide Guidelines for Approving Field-Loadable Software (FLS)
 - To Clarify DO-178B FLS Guidance

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History of FLS

- History
 - ACSEP Evaluation - May 1997
 - FLS Guidance Unclear
 - PMA Policy Did Not Specifically Address Software
 - Notice Drafted to Address FLS and PMA
 - Notice Routed for Comment - Jan. 1998
 - Comments Indicated Need for 2 Notices D N8110.77 and N8110.79

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DO-178B References to FLS

- Field-Loadable Software (FLS) and Loading References:
 - System Design: Sections 2.0 and 2.5
 - SW Process: 6.4.3a., 7.2.1d., e.; 7.2.8, 8.3g.
 - SW Data: 11.1g., 11.2c.(3), 11.4b.(8), (9); 11.10g., 11.11, 11.15, 11.16, 11.20g.

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Notice Outline

- Section 1: Purpose
- Section 2: Distribution
- Section 3: Related Publications
- Section 4: Definitions
- Section 5: Background
- Section 6: Earlier Versions of DO-178
- Section 7: Approval Information
- Section 8: Installation Information
- Section 9: Maintenance and Part Marking

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Definitions (Section 4)

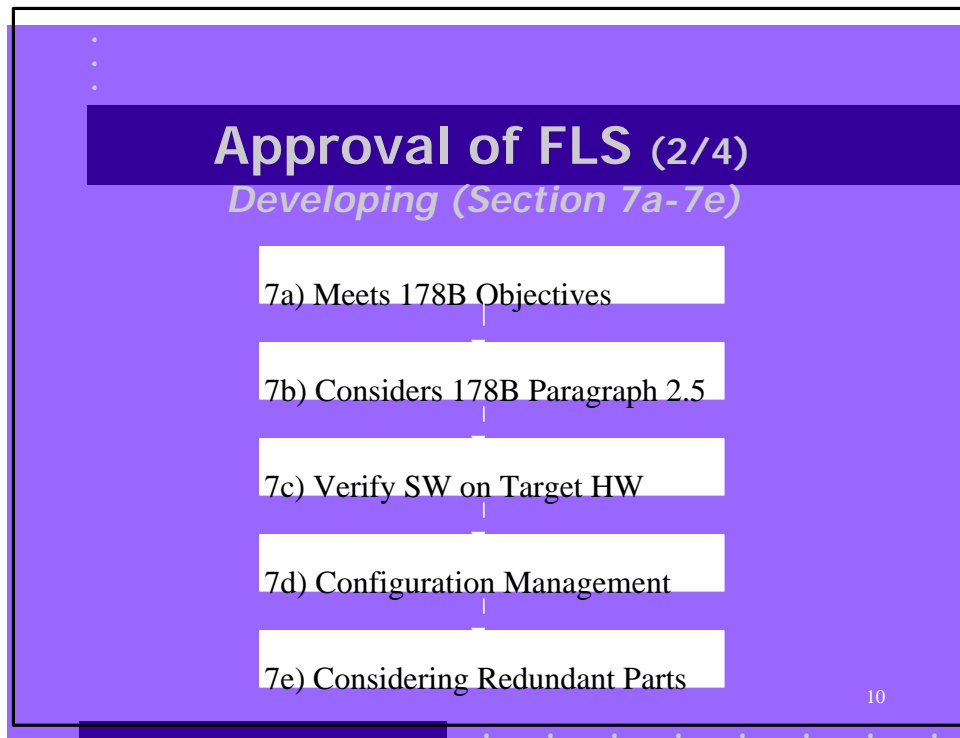
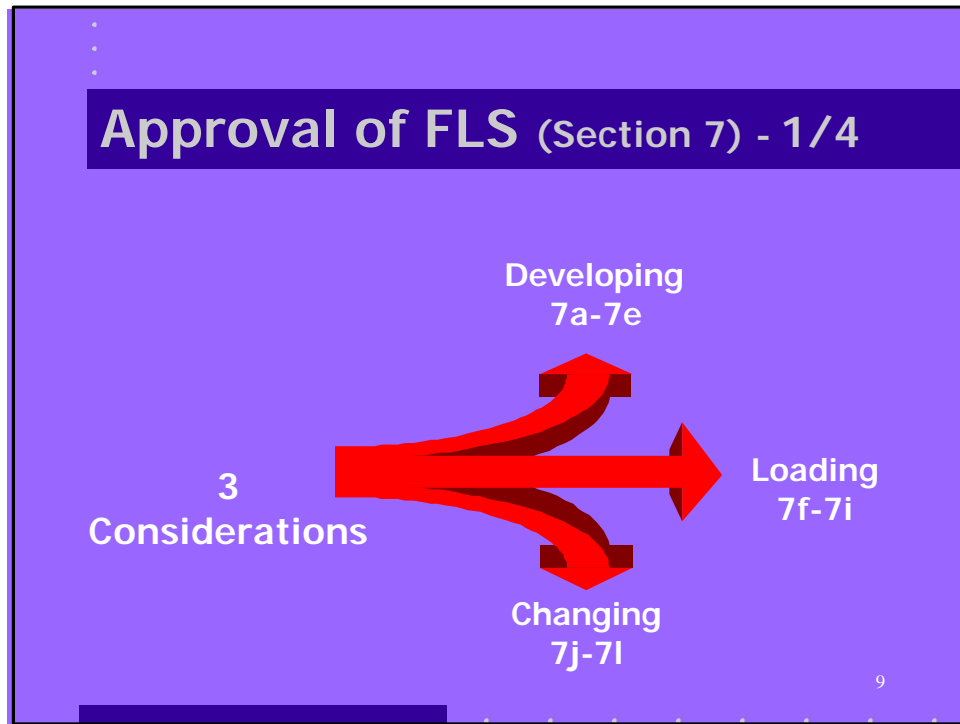
Field-Loadable Software	Software that can be loaded without removal of the equipment from the aircraft installation.
User-Modifiable Software	Software intended for modification by the airplane operator without review by the certification authority, airframer, or equipment manufacturer.
Option-Selectable Software	Software that contains approved and validated components that may be activated by the user.

Examples (Section 4)

- Field-Loadable Software
 - Engine Control Software
 - Flight Control Software
 - Boeing 777 Has Many Systems With FLS
- User-Modifiable Software
 - Electronic Checklists
- Option-Selectable Software
 - Selection Of Sensors For An FMS

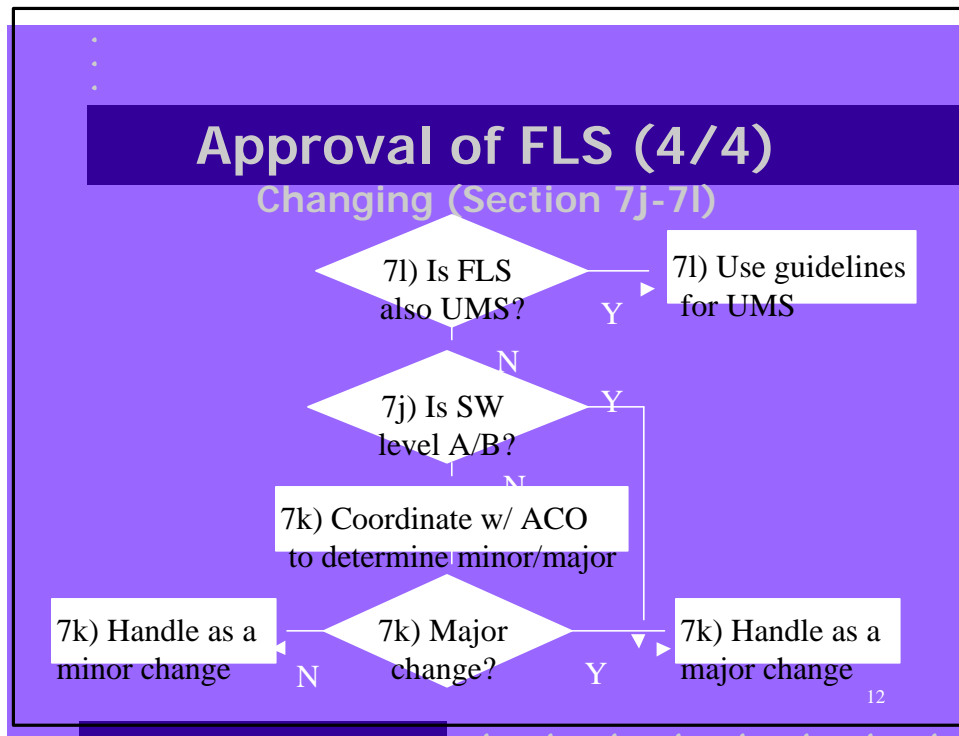
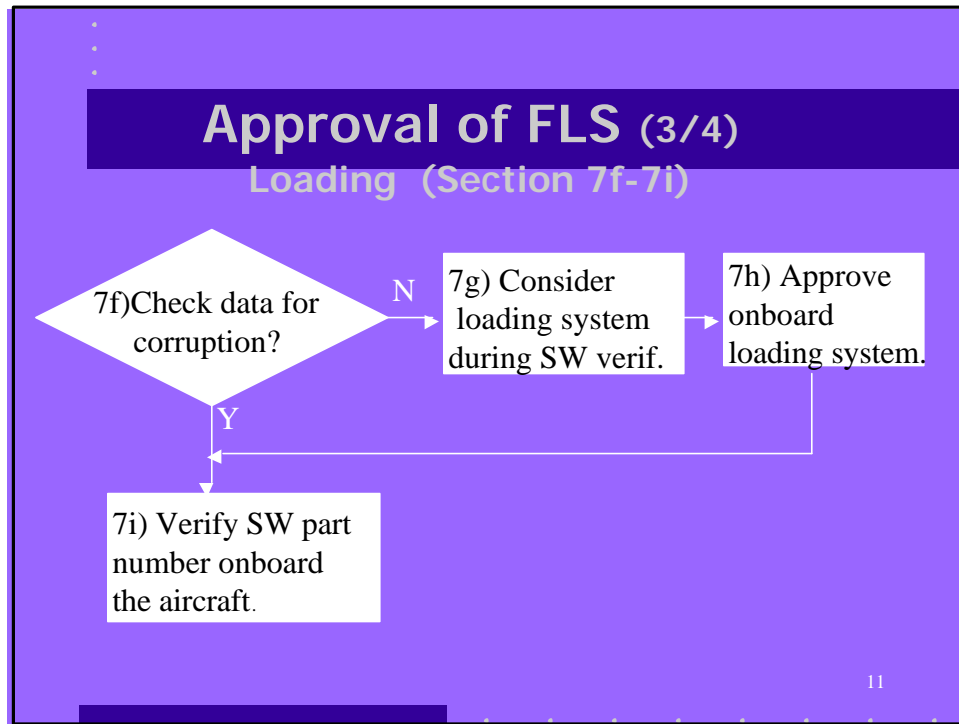
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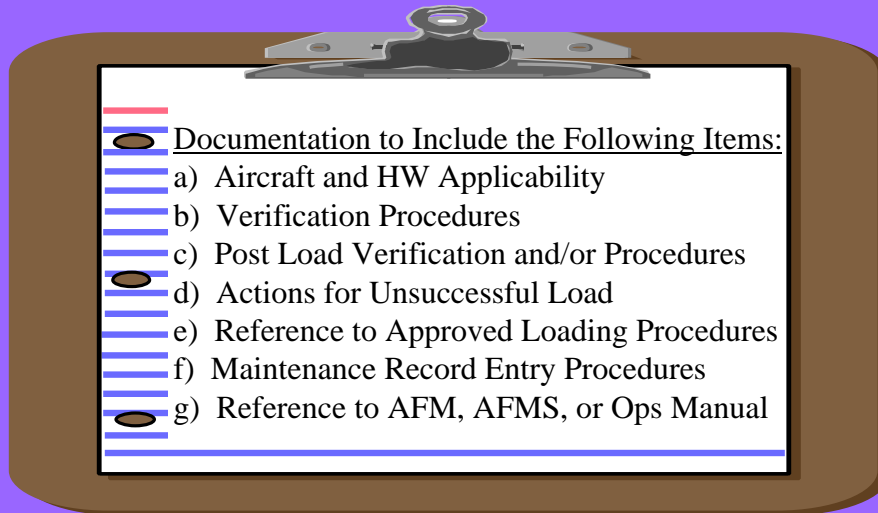
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Installation of FLS (Section 8)



Maintenance & Part Marking of FLS (Section 9) - 1/2

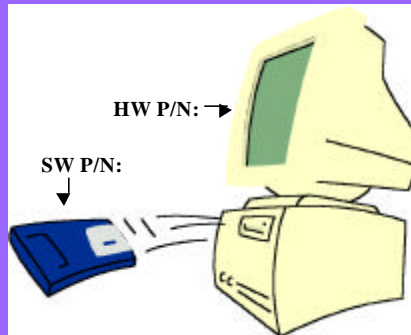
- 9a) Maintenance Procedure in Aircraft Maintenance Manual
- 9b) Procedure to Include Reading of SW Version
- 9c) Procedure to Include Part Number in Maintenance Records
- 9f) Changes Reflected in Appropriate Manual or Logbook

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Maintenance & Part Marking of FLS (Section 9) - 2/2



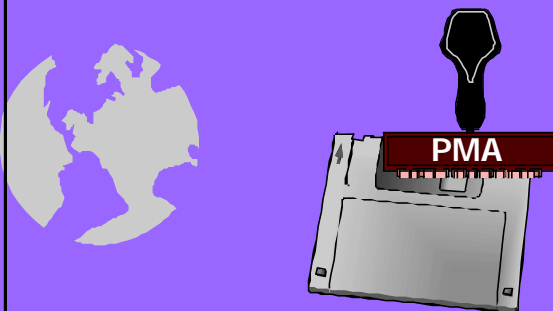
9d) Procedure to Verify
SW Load



9e) Procedure to Verify
Nameplate & SW Load₁₅

Parts Manufacturer Approval of Field-Loadable Software

N8110.79



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Purpose and History

- **PURPOSE OF NOTICE:**
 - Provides Guidelines for Approving FLS Through PMA
 - Limited to Identity With or Without a Licensing Agreement
 - Does Not Cover Test and Computation
- **HISTORY**
 - Started As Part of N8110.77 But Was Separated For Clarity

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Technical Information

- FLS Is Beneficial to Airlines and Applicants
- Order 8110.42, "PMA Procedures," Does Not Specifically Address Software
- CFRs 21.301, 303, and 305 Do Not Specifically Address Software
- Data Being Loaded Is Approved, Not Media

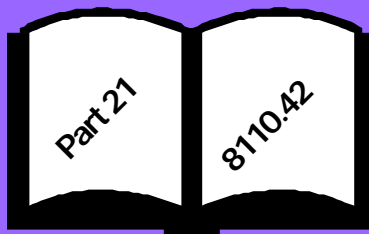
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Procedures (Section 5) - 1/2

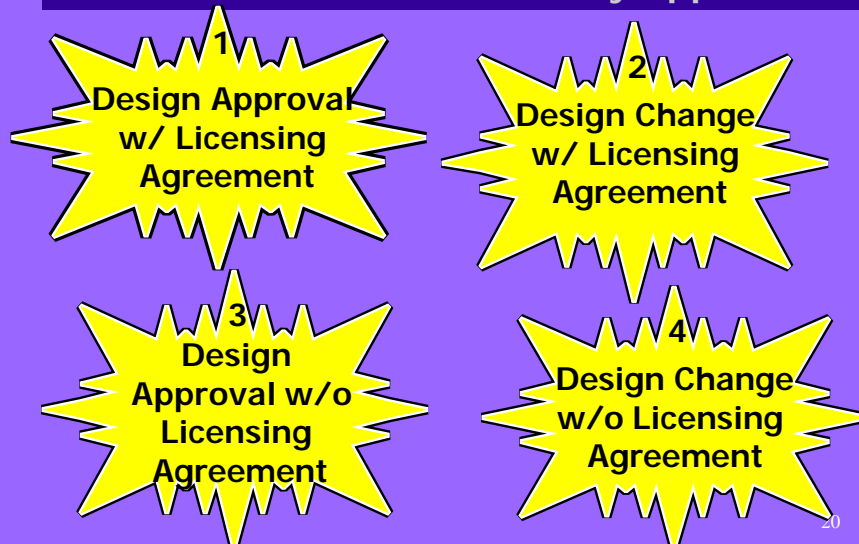
- Follow Part 21 and Order 8110.42 in Conjunction With the Software-Specific Procedures in N8110.79



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Procedures (Section 5) - 2/2

4 Situations For Identity Approval



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Design Approval: Identity with Licensing Agreement (Section 5b(1)a)

- Reference 8110.42, 8(a)(3)(a)
- FLS Should Be Approved Through TC, STC, ATC as Described in N8110.77
- FLS Should Be Installed Via Service Bulletin Or Similar Means
- Configuration Management Process Should Be In Place To Assure Software Part Number, Hardware Part Number, Aircraft Series, etc. Are Accurate

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Design Change: Identity with Licensing Agreement (Section 5b(1)b)

- Reference 8110.42, 8(h)(5)
- Applicant Should Coordinate Change With TC, STC, ATC Holder
- FAA Notice 8110.85 "Guidelines for the Oversight of Software Change Impact Analysis Used to Classify Software Changes as Major or Minor", dated May 11, 2000
- Determine Minor/Major Classification
 - Major change ▸ 8110.42 8(h)(5)(a)
 - Minor change ▸ 8110.42 8(h)(5)

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Design Approval: Identity w/o Licensing Agreement (Section 5b(2)a)

- Order 8110.42, 8(a)(3)(b) - Parts Must Be Identical In "All Respects"
- FLS Should Be Identical To The Software On The TC, STC, ATC Approval
 - Bit-by-bit Comparison
 - Evidence of Identical Type Design Data - DO-178B Section 9.4

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Design Change: Identity w/o Licensing Agreement (Section 5a(2)b)

- Change Considered Major
- Reference 8110.42, 8(h)(5)(a)

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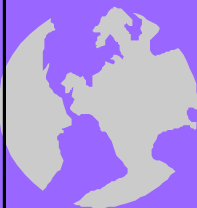
Summary

- Two Notices Related to FLS
 - N8110.77 - Guidelines for Approval of FLS
 - N8110.79 - Guidelines for PMA via Identity for FLS
 - Reference DO-178B, Part 21, and Order 8110.42

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N8110.84

Approval of Airborne Systems and Equipment Containing User-Modifiable Software



Will Struck
FAA TAD ANM-111
will.struck@faa.gov



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Purpose & History

- PURPOSE OF NOTICE
 - To Provide Guidelines To ACO Engineers and DERs For Approval of Systems With User-Modifiable Software (UMS)
 - To Encourage Working With Flight Standards Personnel:
 - Maintenance Inspectors, Avionics Inspectors, and Operations Inspectors
- HISTORY OF NOTICE
 - Started - 1996

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DO-178B References to UMS

- User-Modifiable Software (UMS)
References:
 - System Design: Sections 2.0 and 2.4a.-d.
 - SW Process: 5.2.3, 7.2.2b.
 - SW Data: 11.1g., 11.10g., 11.20g.

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Technical Information

Biggest Concerns:

- ☠ Corruption of Non-modifiable, Safety-related Software
- ☠ Change Control Problems in the Field
- ☠ Compelling but Invalid Information in the Cockpit

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Notice Outline - 1/2

- Sections 1-3: Purpose, Distribution, Related Publications
- Section 4: Definitions
- Section 5: Scope
- Section 6: Earlier Versions of DO-178
- Section 7: Safety Considerations
- Section 8: Displayed Data
- Section 9: Aircraft Performance Parameters
- Section 10: Protection

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Notice Outline - 2/2

- Section 11: Tools
- Section 12: Data Requirements
- Section 13: Other Considerations
- Section 14: Conclusion

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Definitions (Section 4) - 1/2

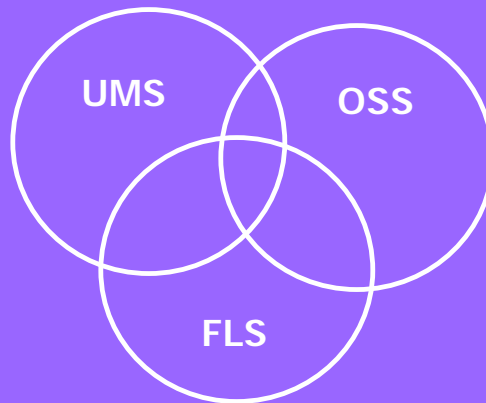
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Definitions (Section 4) - 2/2



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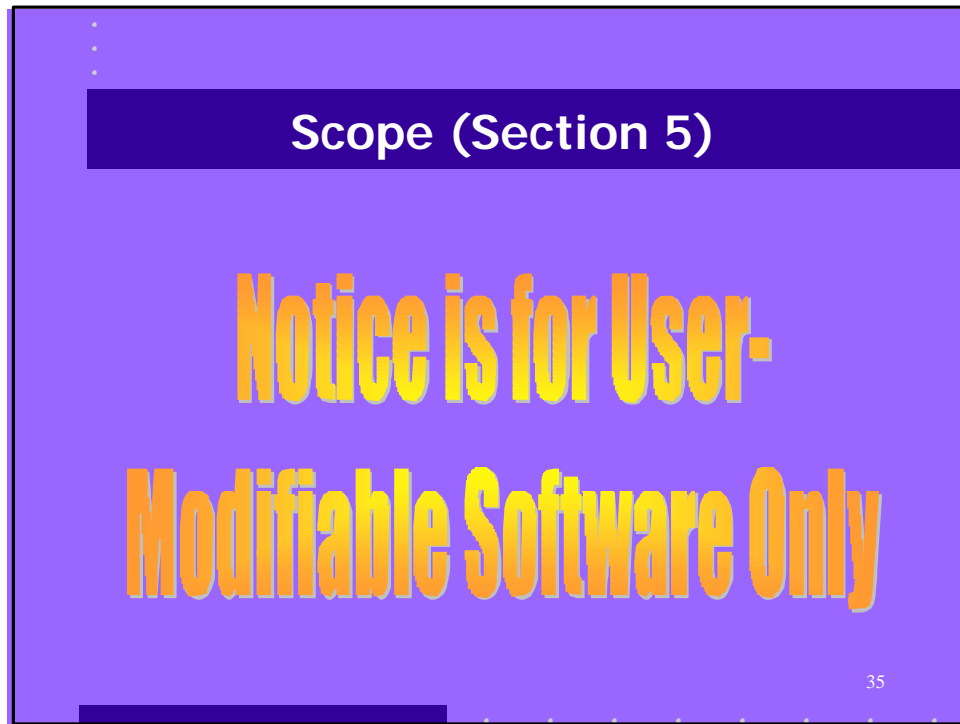
Databases, etc?

- What About Navigation or Terrain Databases?
- What About Programmable Waypoints or Other Programmable Database-Like Items?

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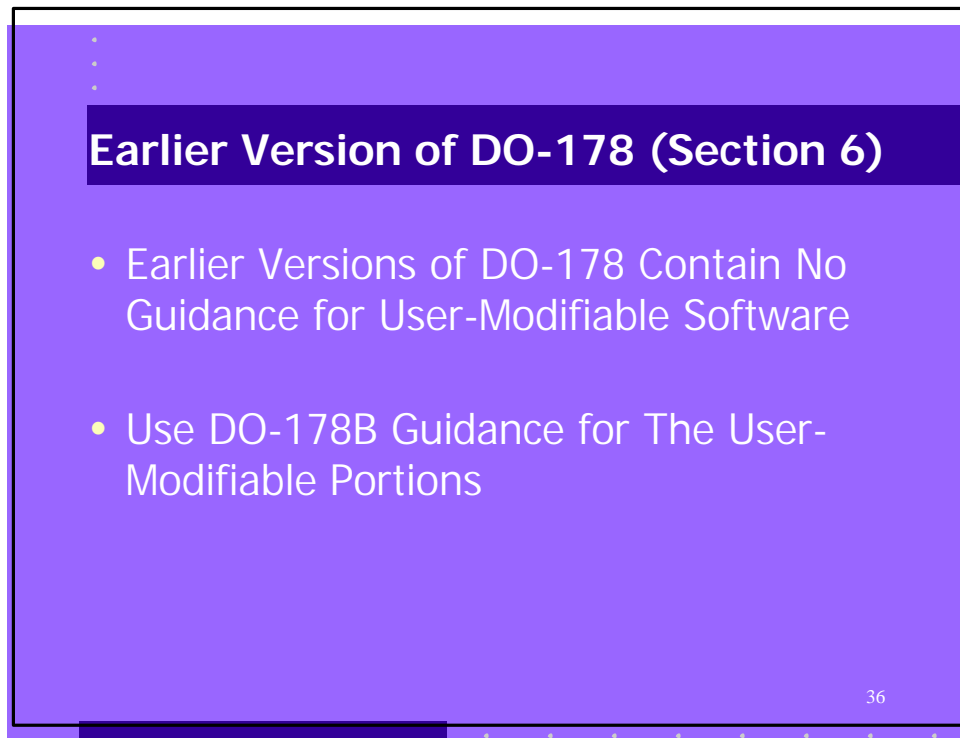


Slide 35 features a purple background with a dark blue header bar. The header bar contains the text "Scope (Section 5)" in white. Below the header, the text "Notice is for User-Modifiable Software Only" is displayed in a large, bold, orange-to-yellow gradient font. The slide number "35" is in the bottom right corner.

Scope (Section 5)

Notice is for User-Modifiable Software Only

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Slide 36 features a purple background with a dark blue header bar. The header bar contains the text "Earlier Version of DO-178 (Section 6)" in white. Below the header, there is a bulleted list with two items. The slide number "36" is in the bottom right corner.

Earlier Version of DO-178 (Section 6)

- Earlier Versions of DO-178 Contain No Guidance for User-Modifiable Software
- Use DO-178B Guidance for The User-Modifiable Portions

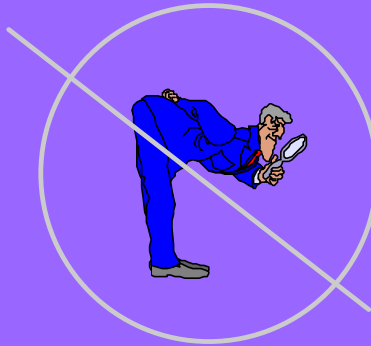
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Safety Considerations (Section 7) - 1/3

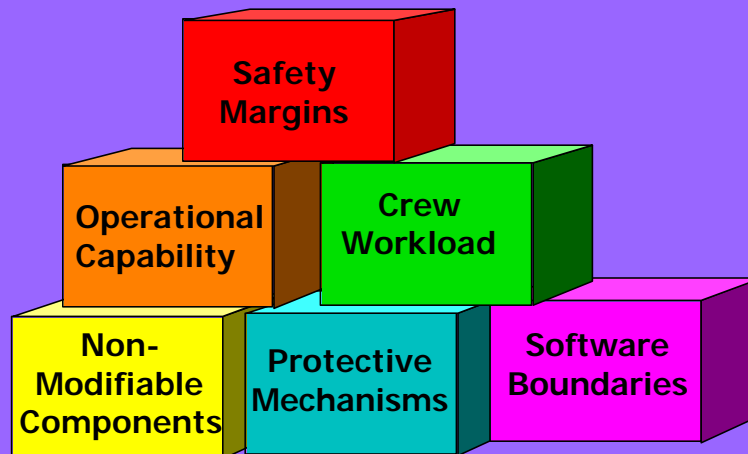
- Once Certified as UMS There is No Certification Authority Oversight



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Safety Considerations (Section 7) - 2/3

Modifications Should Have No Effect On



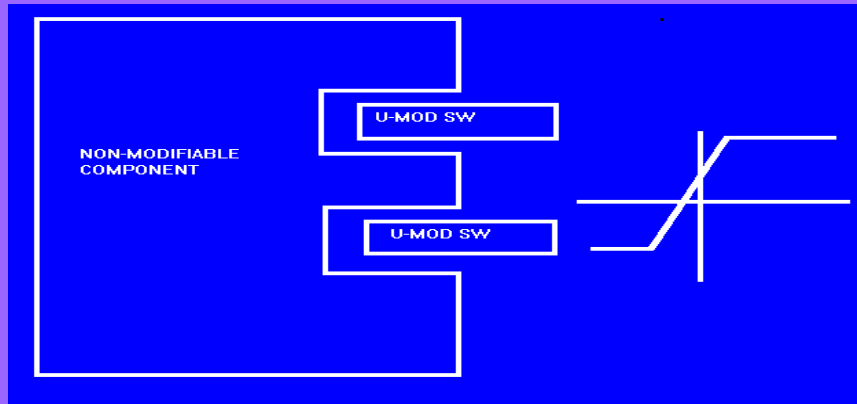
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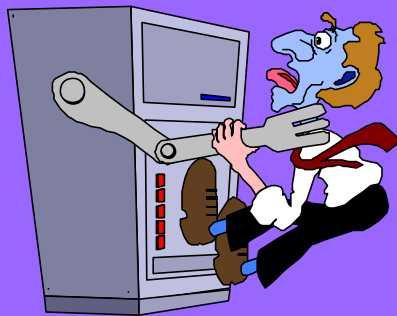
Safety Considerations (Section 7) - 3/3

- Effects Must Be Bounded



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Identification of Displayed Data (Sec. 8)



- Obvious or Explicit Indication That the Data is Not Cert Authority Approved

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General Protection Fault: 31102

MICROSOFT POWER POINT has caused a general protection fault in module KRNL386.exe at 0001:0000751
It has performed an illegal operation. You can push escape to return to Windows and save any unsaved information or you can restart your computer.

- * Press any key to return to Windows
- * Press CTRL+ALT+DEL again to restart your computer
You will lose unsaved information in programs that are running

General Protection Fault: 31102

A fatal error has occurred in the FAT of the disk file system. Unable to recover directory information or cluster links.

- * Any further action could result in severe damage to the hard drive and/or computer
- * Contact the computer vendor with the above code prior to any action.

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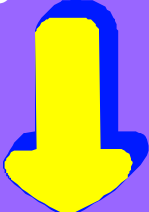
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Performance Parameters (Section 9) - 1/2

- Modifications to Provide or Revise Performance Parameters Requires Certification Authority Review and Approval
- Examples of Parameters
 - Safety margins
 - Operational capabilities
 - Crew workload

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Performance Parameters (Section 9) - 2/2

- Changing Data To Determine Aircraft Performance Parameters = Major Change
- 
- User-Modifiable Designation Lost

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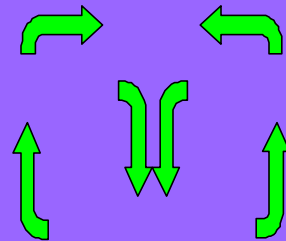
Protection (Section 10) - 1/4

- UMS Components Shouldn't Affect Non-UMS Components
- Assure Protection Is Developed to at Least Same Level of Robustness Required of the Most Robust Non-UMS Component

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Protection (Section 10) - 2/4

- Two Considerations
 - Operating In:
 - Protection in the design and operation
 - Changing Out:
 - Protection during modification



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Protection (Section 10) - 3/4

- Examples
 - Partitioning
 - Hardware Modes
 - Encoding
 - Tools
 - Modifications
 - Loading Protection

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Protection (Section 10) - 4/4



Protect Against Breaches

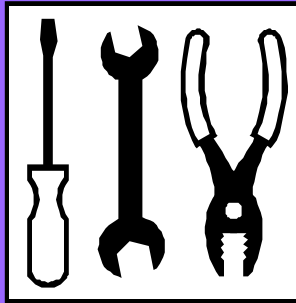
- Accidental Breach
 - Low Likelihood Under Reasonably Probable Circumstances
 - (Subjective statement of probability - not a xx.1309 definition)
- Intentional Breach
 - Low Likelihood Without Undue Effort

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Tools (Section 11) - 1/4

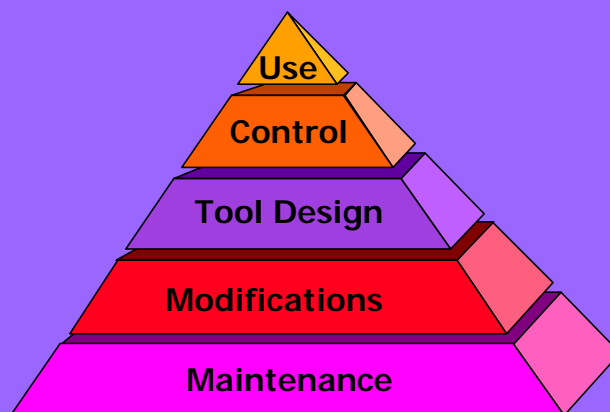


- Used to Enforce Protection
 - Not DO-178B Qualified Tools?
- Demonstrated As the Only Means To Modify UMS Component

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Tools (Section 11) - 2/4

Requires Review and Approval Of:



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Tools (Section 11) - 3/4

Design Approval of Tools

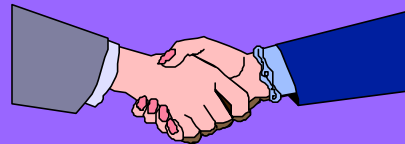


By ACO Engineer

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Tools (Section 11) - 4/4

Maintenance Approval of Tools



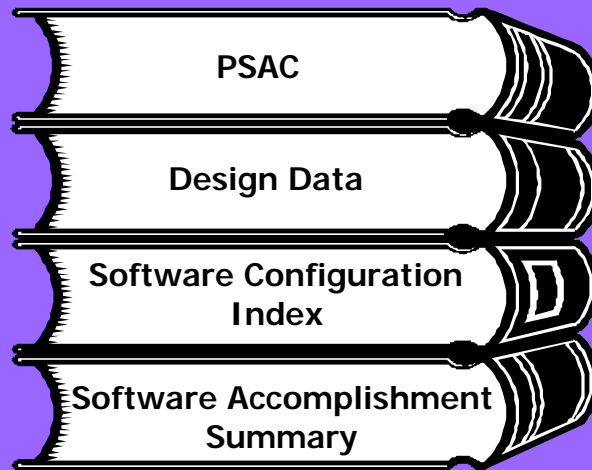
Jointly By:
ACO Engineer
Operational Authority
Maintenance Authority

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Data Requirements (Section 12)



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Other Considerations (Section 13)

- User Follows the Approved Procedures for Modifications to UMS
- User Responsible for Configuration Management, Quality Assurance, and Verification of the Software
- Changing Anything Besides UMS Can Result in Certificate Being Rescinded

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Summary

- N8110.84 Provides Guidelines For Approval of Systems & Equipment Containing UMS
- Provides Guidelines On:
 - Safety Considerations & Safety Parameters
 - Protection
 - Tools
 - Data Requirements
 - Working With FSDO Personnel

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